

REMARKS

Claims 1 – 3, 5 – 10 and 12 – 14 are pending and in consideration in the above-identified application, and Claims 4 and 11 were previously cancelled.

In the Office Action, Claims 1 – 14 were rejected.

In this Amendment, Claims 1 and 8 are amended, and Claims 3, 5 – 7, 10, and 12 – 14 are cancelled. No new matter has been introduced as a result of this Amendment.

Accordingly, Claims 1, 2, 8 and 9 are at issue.

I. 35 U.S.C. § 103 Obviousness Rejection of Claims

Claims 1- 3, 5 – 10 and 12 – 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Publication No. 2002-15771, hereafter referred to as JP'771, in view of Pugh et al. (U.S. Publication 2005/0181283).

Claim 1 is directed to an electrolyte.

In relevant part, Claim 1 recites that:

“...an electrolytic solution containing at least one selected from the group consisting of vinylethylene carbonate and its derivatives in the range of 0.05 wt % to 5 wt % in total; and
a polymer,
said electrolytic solution contains 95 wt % or more of a combination of ethylene carbonate and propylene carbonate, and
.....
said polymer contains any one from the group consisting of polyvinylidene fluoride, polyethylene oxide, polypropylene oxide, poly acrylic nitrile, and poly methacrylic nitrile as a monomer unit.”

That is, the claimed electrolyte contains 95 wt % or more of a combination of ethylene carbonate (EC) and propylene carbonate (PC), and vinylethylene carbonate (VC) and its derivatives in the range of 0.05 wt % to 5 wt % in total. Containing the mentioned ratio of the high dielectric carbonate of EC and PC with little amount of VC in combination and the claimed polymer, good low-temperature characteristics and load characteristics of the battery are obtained without including Gamma-butyrolactone. When Gamma-butyrolactone is present in a solution, low storage characteristics are substantially reduced. The present invention attains the improvement of both the low-temperature characteristics and good storage characteristics

without Gamma-butyrolactone, and both good low-temperature characteristics and good storage characteristics are obtained in combination with the claimed polymer.

In contrast, JP'771 discloses in Paragraphs [0099] – [0101] that (emphasis added):

“[0098] The reason for specifying the rate to the whole non-aqueous solvent of each solvent in said range is explained.

[0099] a. Gamma-butyrolactone (BL)

It is become easy to generate gas at the time of an elevated temperature that the ratio (z) to the whole non-aqueous solvent of BL is under 30 volume %. Moreover, since each of other solvents is annular carbonate, if the ratio of BL is made under into 30 volume %, the ratio of annular carbonate will become high relatively and solvent viscosity will become remarkably high. Consequently, since the conductivity and permeability of nonaqueous electrolyte fall sharply, a charge-and-discharge cycle property and the discharge property under the low-temperature environment near -20 degree C fall. On the other hand, if a ratio exceeds 85 volume %, since the reaction of a negative electrode and BL will arise, a charge-and-discharge cycle property falls. That is, if a negative electrode (for example, thing containing the carbonaceous object which carries out occlusion emission of the lithium ion), and BL react and reduction decomposition of nonaqueous electrolyte arises, the coat which checks a charge-and-discharge reaction on the surface of a negative electrode will be formed. Consequently, since it becomes easy to produce current concentration in a negative electrode, a lithium metal deposits, or the impedance of a negative-electrode interface becomes high, the charge-and-discharge effectiveness of a negative electrode falls to a negative-electrode front face, and the fall of a charge-and-discharge cycle property is caused. A more desirable ratio is 35 volume % - 85 volume %, a still more desirable ratio is below 75 volume % more than 35 volume %, and the most desirable ratio is below 75 volume % more than 55 volume %.

“[0100] b. Ethylene carbonate (EC)

Since there is a possibility that it may become difficult to cover a negative-electrode front face by the protective coat when the ratio (x) to the whole non-aqueous solvent of EC is made under into 15 volume %, the reaction of a negative electrode and BL progresses and it becomes difficult to fully improve a charge-and-discharge cycle property. On the other hand, since there is a possibility that the viscosity of nonaqueous electrolyte may become high and ionic conductivity may fall when the ratio of EC exceeds 50 volume %, it becomes difficult to fully improve a charge-and-discharge cycle property and a low-temperature discharge property. The more desirable range of the ratio of EC is below 50 volume % more than 20 volume %, and the still more desirable range is below 40 volume % more than 20 volume %.

[0101] c. Propylene carbonate (PC)

If the ratio (y) to the whole non-aqueous solvent of PC is made under into 2 volume %, it becomes difficult to carry out eburation of the protective coat on the front face of a negative electrode, the reaction of a negative electrode and BL will progress and it will become difficult to fully improve a charge-and-discharge cycle property and a low-

temperature discharge property. On the other hand, if the ratio of PC exceeds 35 volume %, the viscosity of nonaqueous electrolyte will become high and ionic conductivity will fall. Moreover, the generation of gas at the time of elevated-temperature storage and an initial charge becomes remarkable, and it becomes difficult to fully improve a charge-and-discharge cycle property. The more desirable range of the ratio of PC is below 30 volume % more than 2 volume %, the still more desirable range is below 25 volume % more than 2 volume %, and the still more desirable range is below 20 volume % more than 2 volume %. The most desirable range is below 20 volume % more than 3 volume %.”

Thus, the contents of both EC and PC in the electrolyte taught by JP'771 are in the range of 70 wt % or less based on the fact that the content z of gamma-butyrolactone (BL), given in wt% or volume, is characterized by $30 \leq z \leq 85$, which is outside the “95 wt % or more” range of the combination of EC and PC claimed in the present invention. Moreover, as stated since each of other solvents is annular carbonate, if the ratio of BL is made under into 30 volume %, the ratio of annular carbonate will become high relatively and solvent viscosity will become remarkably high. Consequently, the conductivity and permeability of nonaqueous electrolyte fall sharply, a charge-and-discharge cycle property and the discharge property under the low-temperature environment near -20 degree C fall.

Thus, JP'771 teaches that BL, participating with a necessary ratio is 30 volume % - 85 volume %, is an essential element of the electrolyte to improve low-temperature characteristics. Further, JP'771 teaches that the viscosity of nonaqueous electrolyte becomes high and ionic conductivity falls when the ratio of EC exceeds 50 volume %, and when the ratio of PC exceeds 35 volume %. Therefore, contrary to the Examiner's assertion JP'771 teaches away from the claimed ranges of the combination of EC and PC, which is required to be 95 wt % or more.

Moreover, both JP'771 and Pugh et al. fail to fairly disclose the recited composition of the claimed polymer.

As such, for at least the above discussed limitations, Claim 1 is patentable over JP '771 in view of Pugh et al., as are dependent Claims 2, 3, and 5 – 7, for at least the same reasons.

Independent Claim 8 recites the same distinguishable limitation as that of Claim 1. Thus, Claim 8 is patentable over JP'771 in view of Pugh et al., as are dependent claims 9, 10 and 12 – 14, for at least the same reasons.

Accordingly, Applicants respectfully request that these claim rejections be withdrawn.

II. 35 U.S.C. § 103 Obviousness Rejection of Claims

Claims 1- 3, 5 – 10 and 12 – 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Publication JP’771, in view of Swoyer et al. (U.S. Publication 2006/014078).

The rejection of Claims 3, 5 – 7, 10, and 12 – 14 is now moot in view of their cancellation.

In addition to JP’771, Swoyer et al. also fails to teach or suggest both the claimed electrolyte solution and the polymer. Therefore, Claims 1 and 8 are patentable over JP’771 and Swoyer et al., taken singly or in combination with each other, as are their corresponding dependent claims 2 and 9, for at least the same reasons.

Accordingly, Applicants respectfully request that these claim rejections be withdrawn.

III. 35 U.S.C. § 103 Obviousness Rejection of Claims

Claims 1- 3, 5 – 10 and 12 – 14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Publication JP’771, in view of Japanese publication JP 2001-057234 (JP’234), and further in view of Pugh et al. (U.S. Publication 2005/0181283).

The rejection of Claims 3, 5 – 7, 10, and 12 – 14 is now moot in view of their cancellation.

In addition to JP’771 and Pugh et al., JP’234 both fail to teach or suggest both the claimed electrolyte solution and the polymer. Therefore, Claims 1 and 8 are patentable over JP’771, JP’234 and Pugh et al., taken singly or in combination with each other, as are their corresponding dependent claims 2 and 9, for at least the same reasons.

Accordingly, Applicants respectfully request that these claim rejections be withdrawn.

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IV. Conclusion

In view of the above amendments and remarks, Applicant submits that Claims 1, 2, 8 and 9 are clearly allowable over the cited prior art, and respectfully requests early and favorable notification to that effect.

Respectfully submitted,

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